BS 903 : Part A10 : 1984
ISO 132-1983
UDC 678.4.063 : 678.01 : 620.177

British Standard

Methods of testing vulcanized rubber

Part A10. Determination of flex cracking (De Mattia)

[ISO title: Rubber, vulcanized — Determination of flex cracking (De Mattia)]

Méthodes d'essai des elastomères vulcanisé
Partie A10. Détermination de la résistance au craquelage par flexion (De Mattia)

Prüfverfahren für vulkanisierte Kautschuk
Teil A10. Bestimmung des Widerstandes gegen Rißbildung (De Mattia)

British Standards Institution

Contents

National foreword

This revision of this British Standard has been prepared under the direction of the Rubber Standards Committee. It is identical with ISO 132-1983 'Rubber, vulcanized — Determination of flex cracking (De Mattia)' published by the International Organization for Standardization (ISO).

The 1976 edition of this standard was identical with the first edition of ISO 132 and, consequently, the changes in this revision of the standard correspond to the changes incorporated in the second edition of ISO 132. The main changes are as follows.

(a) The title has been simplified.

(b) A note warning about the effects of significant amounts of ozone in the laboratory atmosphere has been added to clause **0**.

(c) The value and its tolerance for the travel of the lower grip of the De Mattia-type machine and the tolerance on the maximum distance between each set of opposing grips have been altered slightly (see clause **3**).

(d) A reference to ISO 1826 (appendix A to BS 903 : Part A35), for the time-interval between vulcanization and testing, has been added (see **4.2**).

(e) One of the preferred test temperatures is 55 °C, instead of 50 °C (see clause **6**).

This edition of BS 903 : Part A10 supersedes the 1976 edition which is withdrawn.

Terminology and conventions. The text of the international standard has been approved as suitable for publication as a British Standard without deviation. Some terminology and certain conventions are not identical with those used in British Standards; attention is drawn especially to the following.

The comma has been used as a decimal marker. In British Standards it is current practice to use a full point on the baseline as the decimal marker.

Wherever the words 'International Standard' appear, referring to this standard, they should be read as 'British Standard'.

Cross-references

International standard	Corresponding British Standard
	BS 903 Methods of testing vulcanized rubber
ISO 471-1977	Part A35 : 1978 Standard temperatures, humidities and times for the conditioning and testing of test pieces (Identical)
ISO 1826-1981	Part A35 : 1978 Standard temperatures, humidities and times for the conditioning and testing of test pieces (National appendix A is technically equivalent)
ISO 3383-1976	Part A32 : 1977 General directions for achieving elevated or sub-normal temperatures (Identical)

There is no British Standard which corresponds exactly to ISO 133-1981; however this is referred to for information only (see clause **0**) and is very similar to ISO 133-1975 which in turn is identical with BS 903 'Methods of testing vulcanized rubber' Part A11 : 1976 'Determination of resistance to cut growth (De Mattia-type machine)'. A further revision of ISO 133 is in course of preparation and, when this is completed, it is intended to publish a revision of BS 903 : Part A11 which will be identical with the new edition of ISO 133.

Additional information. In UK practice, the standard laboratory temperature is 23 ± 2 °C (see **4.3** and clause **6**).

Textual errors. When adopting the text of the international standard, the textual errors given below were discovered. They have been marked in the text and have been reported to ISO in a proposal to amend the text of the international standard.

In the final paragraph of **4.2**, line 1, 'tests' should be corrected to 'test pieces'.

In the note to clause **0**, line 4, 'million) parts of' should be corrected to 'million parts) of'.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

British Standard

Methods of testing vulcanized rubber

Part A10. Determination of flex cracking (De Mattia)

0 Introduction

Repeated bending or flexing of a rubber vulcanizate causes cracks to develop in that part of the surface where tension stress is set up during flexing or, if this part of the surface contains a crack, causes this crack to extend in a direction perpendicular to the stress. Certain soft vulcanizates, notably those prepared from styrene-butadiene rubber, show marked resistance to crack initiation, but it is possible for these vulcanizates to have a low resistance to growth (propagation) of cracks. It is important, therefore, to measure both the resistance to crack initiation by flexing and the resistance to crack propagation. A method for determining the resistance to growth of an artificially introduced cut is given in ISO 133.

NOTE — The presence of significant amounts of ozone in the laboratory atmosphere affects the results. Periodic checks are advised in order to ensure that the ambient ozone concentration is preferably less than 1 pphm (part per 100 million) parts of air.

1 Scope and field of application

This International Standard specifies a method of test intended for use in comparing the resistance of rubbers to the formation and growth of cracks, when subjected to repeated flexing on the De Mattia-type machine.

2 References

ISO 133, *Rubber, vulcanized — Determination of crack growth (De Mattia).*

ISO 471, *Rubber — Standard temperatures, humidities and times for the conditioning and testing of test pieces.*

ISO 1826, *Rubber, vulcanized — Time-interval between vulcanization and testing — Specification.*

ISO 3383, *Rubber — General directions for achieving elevated or sub-normal temperatures for tests.*

3 Apparatus

The essential features of the De Mattia-type machine are as follows :

Stationary parts, provided with grips for holding one end of each of the test pieces in a fixed position, and similar but reciprocating parts for holding the other end of each of the test pieces. The travel is $57 \, ^{+0,5}_{0}$ mm and is such that the maximum distance between each set of opposing grips is $75 \, ^{+1}_{0}$ mm (see figure 1).

The reciprocating parts are so arranged that their motion is straight, and in the direction of, and in the same plane as, the common centre line of each opposing pair of grips. The planes of the gripping surfaces of each opposing pair of grips remain parallel throughout the motion.

The eccentric which actuates the reciprocating parts is driven by a constant-speed motor to give 5,00 ± 0,17 Hz, with sufficient power to flex at least six, and preferably twelve, test pieces at one test. The grips hold the test pieces firmly, without undue compression, and enable individual adjustment to be made to the test pieces to ensure accurate insertion.

For testing at elevated temperatures, the machine may be enclosed in a chamber with temperature control near the centre of the test piece to ± 2 °C, if necessary, by using an air circulator.

NOTE — It is useful to arrange the test pieces in two equal groups, so that one group is being flexed while the other group is being straightened, thus reducing the vibration in the machine.

4 Test piece

4.1 Form and dimensions

The test piece shall be a strip with a moulded groove, as shown in figure 2. The strips may be moulded individually in a multiple-cavity mould or may be cut from a wide slab having a moulded groove.

The groove in the test piece shall have a smooth surface and be free from irregularities from which cracks may start prematurely. The groove shall be moulded into the test piece or slab by a half-round ridge in the centre of the cavity. This half-round ridge shall have a radius of 2,38 ± 0,03 mm. The moulded groove shall be perpendicular to the direction of calendering.

The results shall be compared only between test pieces having thicknesses agreeing within the tolerances, when measured close to the groove, because the results of the test are dependent upon the thickness of the test piece.

*See national foreword for details of textual error.

4.2 Time interval between vulcanization and testing

For all test purposes, the minimum time between vulcanization and testing shall be 16 h in accordance with ISO 1826.

For non-product tests, the maximum time between vulcanization and testing shall be 4 weeks, and for evaluations intended to be comparable, the tests, as far as possible, should be carried out after the same time interval.

* As far as possible, samples and tests shall be kept away from exposure to light.

4.3 Conditioning

For tests at a standard laboratory temperature (see clause 6) : individually moulded test pieces, after preparation as necessary, shall be conditioned at the test temperature for a minimum of 3 h immediately before testing, the same test temperature being used throughout any test or series of tests intended to be comparable. Slab samples shall be similarly conditioned before the test pieces are cut. These test pieces may be either tested immediately or kept at the test temperature until tested.

For tests at other temperatures (see clause 6) : after the conditioning period specified above, the test pieces shall be brought to the test temperature by keeping in a chamber at this temperature for 3 h. (See ISO 3383.)

4.4 Number of test pieces

At least three, and preferably six, test pieces from each rubber compound shall be tested, and the results averaged, one or more test pieces being tested simultaneouly with those of other rubbers with which the comparison is to be made.

5 Procedure

Separate the pairs of grips to their maximum extent, and insert the test pieces so that they are flat and not under tension, with the groove in any particular test piece midway between the two grips in which that test piece is held, and on the outside of the angle made by the test piece when it is bent.

Start the machine and continue the test with frequent inspection until the first minute sign of cracking is detected. Record the number of flexing cycles at this point, restart the machine and stop it after intervals in which the number of flexing cycles is increased in geometric progression, a suitable ratio being 1,5 on each occasion. Make the inspection of the flexed test pieces each time with the grips separated to a distance of 65 mm.

It is not desirable to run the test piece until complete rupture occurs, the preferred method being to grade the severity of cracking by comparison with a standard scale of cracked test pieces, as specified in clause 7. The comparison includes an assessment of the length, depth and number of cracks.

The test shall not be made in a room which contains any apparatus that generates ozone, such as a fluorescent lamp, or which for any reason has an ozone content above that in normal indoor air. The motor used to drive the test machine shall be of a type that does not generate ozone.

The results shall be recorded as follows :

a) the grade of cracking reached by each test piece on each occasion the machine is stopped;

b) the flexing cycles which have been run.

6 Temperature of test

Tests are normally performed at standard laboratory temperatures as defined in ISO 471, although elevated temperatures may often be used with advantage. In the latter case, the test temperature shall be one of the preferred temperatures 40, 55, 70, 85, 100, 125, 150 °C.

7 Expression of results

Cracking shall be graded according to the following scale :

Grade 1

The cracks at this stage look like pin pricks to the naked eye.

Grade as 1 if the "pin pricks" are 10 or less in number.

Grade 2

Assess as Grade 2 if either of the following applies :

a) the "pin pricks" exceed 10 in number;

b) the number of cracks is less than 10, but one or more cracks have developed beyond the "pin prick" stage, i.e. have perceptible length without much depth but their length is not more than 0,5 mm.

Grade 3

One or more of the "pin pricks" have become obvious cracks, i.e. have appreciable length and little depth and their length is greater than 0,5 mm but not greater than 1 mm.

Grade 4

The length of the largest crack is greater than 1 mm but not greater than 1,5 mm.

Grade 5

The length of the largest crack is greater than 1,5 mm but not greater than 3 mm.

Grade 6

The length of the largest crack is greater than 3 mm.

*See national foreword for details of textual error.

NOTES

1 No distinction is made between cracks that have grown in isolation and those that have grown by coalescence.

2 *Cracks occurring near the edge of the test piece shall be ignored.*

Plot the grades from 1 to 6 against the number of corresponding kilocycles of flexing on linear graph paper and draw a smooth curve through the points. Using graphical interpolation, deduce the number of kilocycles for each grade of cracking.

8 Test report

The test report shall include the following information :

a) reference to this International Standard;

b) the average number of kilocycles to reach each grade of cracking 1 to 6, given in clause 7, or

the mean flex cracking resistance, determined by the number of kilocycles to reach grade 3 or the number of kilocycles, preferably 10, 50 or 100, as appropriate, at which no cracks occur;

c) the number of test pieces used;

d) temperature of test.

Dimensions in millimetres

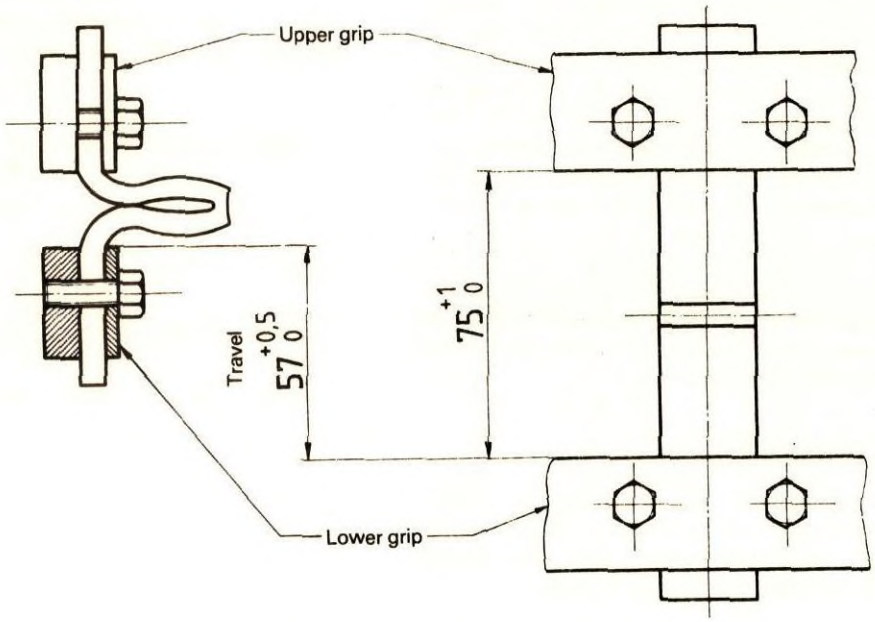

Figure 1 — De Mattia-type machine

Dimensions in millimetres

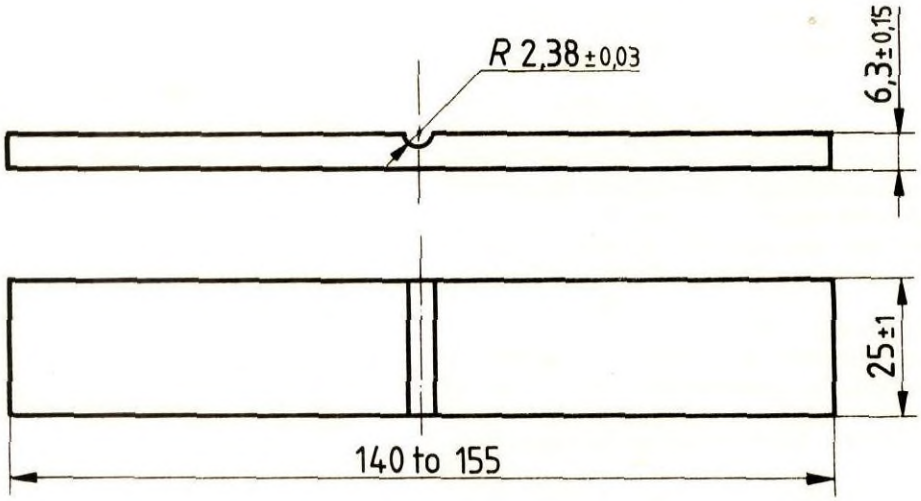

Figure 2 — Test piece

Publications referred to

See national foreword.

BS 903 : Part A10 : 1984
ISO 132-1983

This British Standard, having been prepared under the direction of the Rubber Standards Committee, was published under the authority of the Board of BSI and comes into effect on
31 January 1984.

First published as BS 903 June 1940
First revision October 1950
First published as BS 903 : Part A10 April 1956
First revision November 1976
Second revision January 1984

ISBN 0 580 13669 8

British Standards Institution
Incorporated by Royal Charter, BSI is the independent national body for the preparation of British Standards. It is the UK member of the International Organization for Standardization and UK sponsor of the British National Committee of the International Electrotechnical Commission.

Contract requirements
A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Revision of British Standards
British Standards are revised, when necessary, by the issue either of amendments or of revised editions. **It is important that users of British Standards should ascertain that they are in possession of the latest amendments or editions.** Information on all BSI publications is in the *BSI Catalogue*, supplemented each month by *BSI News* which is available to subscribing members of the Institution and gives details of new publications, revisions, amendments and withdrawn standards. Any person who, when making use of a British Standard, encounters an inaccuracy or ambiguity, is requested to notify BSI without delay in order that the matter may be investigated and appropriate action taken.

The following BSI references relate to the work on this standard:
Committee reference RUC/36
Draft announced in *BSI News* August 1983

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Rubber Standards Committee (RUC/—) to Technical Committee RUC/36 upon which tne following bodies were represented:

British Railways Board
British Rubber Manufacturers' Association
ERA Technology Ltd.
Institution of Mechanical Engineers
Institution of Water Engineers and Scientists
Malaysian Rubber Producers' Research Association
Ministry of Defence
National College of Rubber Technology
Rubber and Plastics Research Association of Great Britain
Satra Footwear Technology Centre
Scientific Instrument Manufacturers' Association (BEAMA)
Coopted member

Amendments issued since publication

Amd. No.	Date of issue	Text affected

BS 903 : Part A10 : 1984
ISO 132-1983